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(56) Documents Cited
GB 1598355 A US 5338493 A US 4291536 A
US 4189254 A

(58) Field of Search
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(54) Improvements in or relating to disposal of waste

(57) Heat-emitting waste is disposed in an underground chamber such as bore hole 12. Waste units 10 are stacked, possibly with interposed heat-conducting elements 11, and a tube 21 delivers cooling liquid to a lower depth. The liquid rises and heats up. A heat exchanger 15, 16 may remove heat from an upper region. The removal of heat reduces heating of surrounding rock.

Heat removal may be by elements 11.

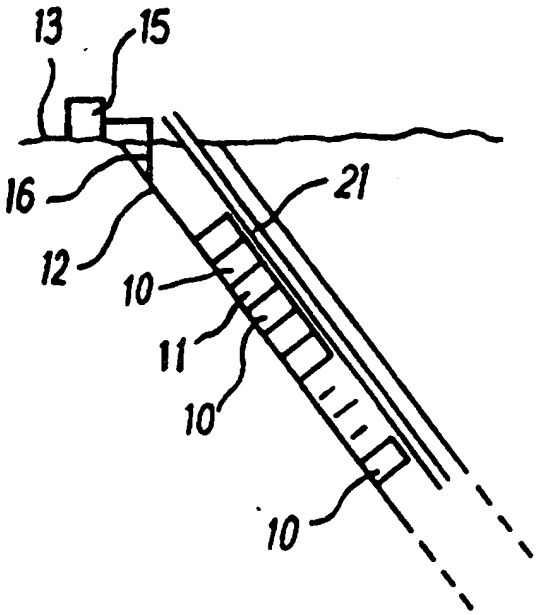

FIG. 2

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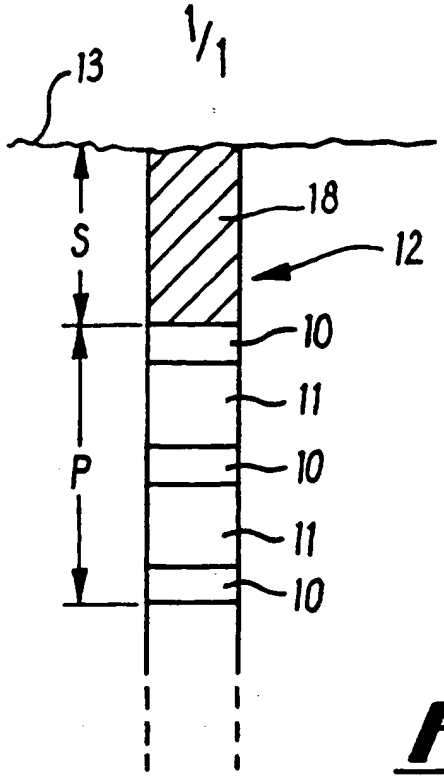

FIG. 1

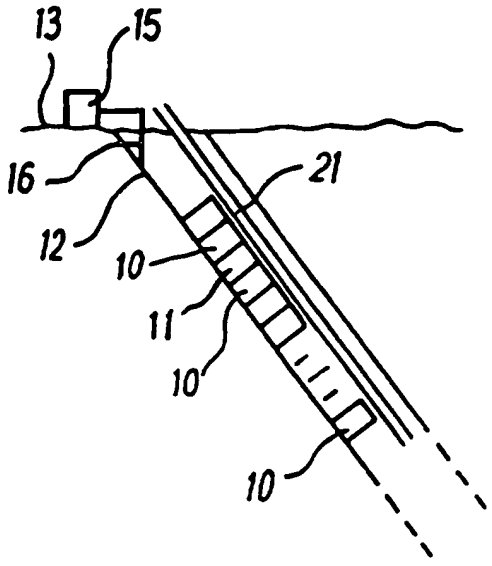

FIG. 2

IMPROVEMENTS IN OR RELATING TO DISPOSAL OF WASTE

THIS INVENTION relates to the disposal of waste, particularly waste which emits heat.

An example of heat-emitting waste (HEW) is vitrified high (radio) active liquor (HAL) from a nuclear reactor.

The disposal of Heat-Emitting Waste (HEW), by burial in close contact with rock, raises the temperature of the rock appreciably because the latter is a poor thermal conductor. It is conventionally assumed that rock must not rise above 100°C to preserve its integrity; accordingly, it is often presumed that HEW must be at least 50 years old (dated from when its active isotopes were last in a reactor neutron flux). By this time, the heat emission will have decayed down so that the eventual adjacent rock temperature after burial only reaches a maximum of 100°C.

According to this invention a method of disposal of heat-emitting waste in a chamber beneath ground comprises providing heat transfer means in heat transfer relationship with the disposed waste to reduce the heat transferred to the region surrounding the waste.

The heat transfer means may be such as to flow between higher positions so as to transfer heat from a greater to a lesser depth.

The method may comprise removing heat from an upper region of the chamber.

The heat transfer material may be pumped to the lower position. The chamber may be a bore hole.

The waste may be in individual units and heat-conducting material may be interposed between adjacent units. The units and interposed material may form a stack.

The waste may be in a chamber with a tube extending into the chamber for delivering cooling fluid e.g. water to a lower region of the chamber.

The invention provides a waste-disposal site formed as above.

The invention may be performed in various ways and one specific embodiment with possible modifications will now be described by way of example with reference to the accompanying schematic drawings, in which:-

Figs. 1 and 2 are illustrations of waste disposal in a bore hole.

In general, the arrangements to be described in more detail below avoid the need for storage on the surface by transferring heat by conduction or convection, so that the heat can be dissipated at a distance from the waste in a manner which avoids high rock temperatures at any point in a disposal bore hole.

In the example of Fig. 1, the heat output per metre of bore hole is diluted or reduced by interspersing HEW packages or blocks 10 with heat conductors 11, in a bore hole 12. Ground surface is at 13. S is the safe burial depth and P is the pay load distance i.e. the distance occupied by waste 10 and conductors 11. The conductors may for example be iron or steel or copper rods.

The space S is full of backfill 18 e.g. water-impervious clay.

The bore hole may have a casing e.g. concrete or steel.

Other wastes with heat-emitting constraints e.g. spent

reactor fuel, could be dealt with as HEW above with the required geometrical adjustments. Overpack material around the waste units is provided to give strength to withstand the weight of material stacked above and also as a barrier to release of radioactivity for many years.

Cast steel or malleable iron could be possible materials for conductors if the bore hole is in fresh ground water.

In another arrangement shown in Fig. 2 the bore hole 12 is slightly sloped (exaggerated in Fig. 2) so that waste units stack along one side of the bore hole. A tube 21 can then be moved into position to extend along the bore hole to pump in cooling water at say 30 gallons per minute (138 litres/min) at the bottom to cause a flow of water upwards, carrying heat away from the waste. When cooling is no longer required, the tube 21 can be used to supply grout to fill up the bore hole, being progressively raised as grouting proceeds. In a modification only that part of the bore hole in which waste is stored is inclined, the upper portion being vertical.

If desired, heat transfer means 11 can also be placed between blocks 10 in Fig. 2.

There may be a device 15 Fig. 2 thermally connected at 16 to a top region of the bore hole to abstract heat from the fluid e.g. by a heat-exchanger.

The waste may be placed in an underground chamber other than a bore hole.

CLAIMS

1. A method of disposal of heat-emitting waste in a chamber beneath ground providing heat transfer means in heat transfer relationship with the disposed waste to reduce the heat transferred to the region surrounding the waste.

2. A method as claimed in Claim 1, in which the heat transfer means is such as to flow between lower and higher positions so as to transfer heat from a greater to a lesser depth.

3. A method as claimed in Claim 2, in which the heat transfer material is pumped to the lower position.

4. A method as claimed in any preceding claim, comprising removing heat from an upper region of the chamber.

5. A method as claimed in any preceding claim, in which the waste is in individual units and heat-conducting material is interposed between adjacent units.

6. A method as claimed in Claim 5, in which the units and interposed material form a stack.

7. A method as claimed in any preceding claim, in which the chamber is in the form of a bore hole.

8. A method as claimed in any preceding claim, in which a

tube extends into the chamber for delivering cooling fluid to a lower region of the chamber.

9. A method of disposal of heat-emitting waste as claimed in Claim 1, and substantially as hereinbefore described.

10. A waste disposal site formed by a method as claimed in any preceding claim.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search report)

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Relevant Technical Fields

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(ii) Int Cl (Ed.6) G21F

Search Examiner
M CONLON

Date of completion of Search
27 FEBRUARY 1996

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii)

Documents considered relevant following a search in respect of Claims :-
1-10

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1598355	(WP-SYSTEM) Figure 5	1-6 at least
X	US 5338493	(WELCH) whole document	1-10
X	US 4291536	(GIRARD) column 2 line 23 to column 3 line 1	1-6 at least
X	US 4189254	(AKESSON) Figure 2 and related description	1-6 at least

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).